

Diminished Protection? Early Childhood PCB Exposure and Reduced Immune Response to Vaccinations

Polychlorinated biphenyls (PCBs) constitute a class of persistent organic pollutants suspected or known to cause adverse health effects. Among these effects are immune system dysfunctions that may hinge on both the magnitude and the timing of PCB exposure. A new study uses the backdrop of routine childhood immunizations to explore the developmental immunotoxicity of PCBs and finds that higher PCB exposure in toddlerhood is associated with reduced antibodies against diphtheria and tetanus later in childhood [*EHP* 118(10):1434–1438; Heilmann et al.].

The study took place in the Faroe Islands, midway between the Shetland Islands and Iceland in the North Atlantic, and involved 587 children from a 1999–2001 birth cohort. A traditional diet including pilot whale blubber, consumed by some but not all Faroese, creates a wide range of PCB exposures for this population. To assess the transfer of PCB from a mother to her child, maternal blood samples were taken in week 32 of pregnancy. The mothers also provided milk samples at 4–5 days after birth.

Based on the routine vaccination schedule, children were immunized against diphtheria and tetanus at 3, 5, and 12 months, with a booster at 5 years. Approximately one-fifth of the children had blood drawn at 18 months, and blood samples were drawn



before the booster shots at age 5 years for 532 children and 7 years for 464 children. PCB concentrations were assessed in blood and milk samples, and diphtheria and tetanus antibodies were measured in children's blood at ages 5 and 7.

Analysis revealed inverse relationships between PCB concentrations at different time points and antibody concentrations. The associations between concomitant measurements were not significant at either 5 or 7 years. However, higher PCB concentrations in mother's milk samples collected after birth and in children's blood samples at 18 months were clearly associated with lower levels of diphtheria antibodies in the children at age 5. When PCB concentrations at 18 months were estimated for the entire cohort based on known levels at birth and at 5 years paired with breastfeeding duration and PCB concentrations measured in blood samples from a subset of children at 18 months, this relationship became even stronger for diphtheria at both 5 and 7 years, and a similar relationship for tetanus antibody concentration at age 7 became significant.

The authors point out that early-life PCB exposure may increase the risk of incomplete protection against diphtheria and possibly tetanus even if a child receives a full schedule of vaccinations. But the implications of the results extend beyond vaccination because diphtheria and tetanus immune response reflects the efficacy of the immune system against a broad array of infections.

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Thyroid Insult Flame Retardants Linked to Alterations in Pregnant Women's TSH Levels

Polybrominated diphenyl ether (PBDE) flame retardants have been added to a wide variety of U.S. consumer goods including automobiles, airplanes, electronics, home furnishings, and furniture. Although two forms of PBDEs were phased out of use by 2004, data from the Centers for Disease Control and Prevention suggest exposure to these persistent, bioaccumulative, potentially toxic compounds remains widespread among the general U.S. population. New research now links higher exposure to PBDEs with reduced levels of thyroid-stimulating hormone (TSH) and higher rates of subclinical hyperthyroidism in women [*EHP* 118(10):1444–1449; Chevrier et al.]. The findings may have implications for maternal health and fetal development.

Thyroid hormones are known to play an essential role in fetal brain development, and altered maternal thyroid hormone levels may adversely affect child neurodevelopment. The authors cite multiple animal studies showing that PBDEs alter pregnant rodents' thyroid functioning. In the last year, laboratory tests using human cells suggested that PBDEs may affect brain development and linked the alterations to disruptions in thyroid hormone signaling. Recent research also has linked higher PBDE exposure to reduced intelligence in children.

The authors believe their new study to be the largest to analyze associations between PBDEs and thyroid hormone during

pregnancy. The 270 study participants were pregnant in 1999 and 2000 when they were recruited for the Center for Health Assessment of Mothers and Children of Salinas (CHAMACOS) study. The research team measured the women's thyroid hormone levels, then evaluated the data with models that adjusted for potential confounding factors, such as demographic characteristics and exposure to other persistent, bioaccumulative, and toxic compounds.

Women with higher blood PBDE levels had lower levels of TSH. The women with the highest levels of PBDEs were more likely to have lower TSH but normal levels of the thyroid hormone thyroxine (T_4), suggesting subclinical hyperthyroidism. The combination of lower TSH and "normal" T_4 —as defined by the reference range applied to lab results—could mean an individual's T_4 levels actually are elevated above her body's "set point" (or optimal level) of T_4 , which varies from person to person.

Most human studies in this area have associated increased exposure to PBDEs with elevated free T_4 . The only other study known to examine PBDEs and thyroid hormone specifically in pregnant women—which included only nine women—did not find increased T_4 , but the authors did not examine TSH levels. In contrast, other studies of pregnant women's thyroid hormone levels have linked higher exposure to organochlorine pesticides and polychlorinated biphenyls—which have chemical structures and properties similar to those of PBDEs—with increased TSH and decreased T_4 .

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